

## REMARKS

Claims 1-3, 9-21, and 25-32 are pending in this application. By this Amendment, claims 1, 2, 9-13, 25-29, and 31-32 are amended. Reconsideration in view of the above amendments and following remarks is respectfully requested.

**1. 35 U.S.C. §112**

The Office Action rejects claims 1-3, 9-21, 25 and 27-31 under 35 U.S.C. §112, first paragraph. Applicants submit that the above amendments obviate the rejection. Withdrawal of the rejection is respectfully requested.

**2. 35 U.S.C. §102(b)/103(a)**

The Office Action rejects all pending claims under 35 U.S.C. §102(e) or 103(a) over the various cited references. The rejection is respectfully traversed.

**a. *Wang et al.***

Claims 1-3, 9-21, 25, and 27-32 are rejected over *Wang et al* (U.S. Patent Publication No. 2003/0111181, hereinafter referred to as "*Wang*") in view of various other cited references.

Claim 1 has been amended to recite an inductively coupled plasma (ICP) generating apparatus comprising: an evacuated reaction chamber; an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna, wherein the antenna comprises a plurality of coils

comprising a first continuous serpentine coil, a second continuous circular coil, and a third continuous serpentine coil surrounding the first continuous serpentine coil, wherein the first and third serpentine coils are bent in a zigzag pattern, and wherein the first and third serpentine coils comprise an outer loop, an inner loop, and connecting portions between the outer loop and the inner loop, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil.

*Wang* discloses a three multi-loop inductive antennas 910, 920, 930, which may be of the type of any one of the embodiments of Figures 1-8. See *Wang* paragraph [0043]. However, *Wang* fails to disclose or suggest a third serpentine coil, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil. Rather, the antennas of Figures 1, 2, 7, and 8 are overlapping coils 260a, 260b with radial paths 230a, 230b of equal lengths; the antennas of Figures 4 and 5 are loop pairs formed by conductors 305-1,

305-2, 305-3; and the antenna of Figure 6 is a conductor 605 that defines a number of equally spaced triangular loops 610a, 610c, 610e. Thus, even though *Wang* discloses that the antennas of Figures 1-8 can be substituted into Figure 9, the antennas in Figures 1-8 even if provided in Figure 9 do not disclose or suggest the combination of features of claim 1.

Additionally, as explained in paragraphs [0071]-[0073] in the publication (US Pat. Pub. No. 2004/0079485 A1) of the present application, a second serpentine coil 326 placed around a first serpentine coil 324 (as illustrated in Figures 11, 12G, and 14) can have as many zigzags as the first serpentine coil 324, wherein the magnetic field distribution at the edge portion of the reaction chamber can be easily controlled by the second serpentine coil 326. Thus, the uniformity of plasma density in the reaction chamber can be optimized by appropriately designing the outermost second serpentine coil 326 in a zigzag pattern. See paragraph [0072]. Also, when an antenna has an additional outermost serpentine coil in an appropriate zigzag pattern, the inductance of the antenna is lower compared to a two-turn coil antenna without an outermost serpentine coil. See paragraph [0073].

Similarly, claim 28 recites an inductively coupled plasma (ICP) generating apparatus comprising: an evacuated reaction chamber; an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna, wherein the antenna comprises a coil comprising a serpentine continuous first portion, a separate circular continuous second portion connected

end to end to one another, and a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion.

Again, *Wang* fails to disclose or suggest the combination of features of claim 28, including at least the feature of a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion.

Also, claim 32 recites an inductively coupled plasma (ICP) generating apparatus comprising: an evacuated reaction chamber; an antenna installed at an upper portion of the reaction chamber to induce an electric field for ionizing reaction gas supplied into the reaction chamber and generating plasma; and a radio frequency (RF) power source connected to the antenna to apply radio frequency power to the antenna, wherein the antenna comprises three coils: a first center, circular coil; a second coil surrounding the first coil; and a third coil communicatively connecting the first coil to the second coil; wherein the second coil has inner portions complementary to the outer surface of the first coil, outer portions complementary to the inner surface of the third coil and connecting portions connecting the inner portions and the outer portions, wherein the third coil has inner portions complementary to the outer surface of the second coil, outer portions complementary to the inner surface of the reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another.

Again, *Wang* fails to disclose or suggest the combination of features of claim 32, including at least the features a third coil having inner portions complementary to an outer surface of a second coil, outer portions complementary to an inner surface of a reaction chamber and connecting portions connecting the inner portions and the

outer portions, and wherein the first, second and third coils do not overlap one another.

The additional cited references do not cure the deficiencies of *Wang*, therefore Applicants submit that for at least the reasons set forth above, claims 1, 28 and 32 is allowable. Claims 2, 3, 9-21, 25, and 27 depend from claim 1 and claims 29-31 depend from claim 28, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

b. *Ishii et al.*

Claims 1-3, 9-21, 25, and 27-32 over *Ishii et al.* (U.S. Patent No. 5,938,883, hereinafter referred to as "*Ishii*") in view of various other cited references. This rejection is respectfully traversed.

Similar to *Wang*, *Ishii* also fails to disclose or suggest the combination of features mentioned above from claims 1, 28 and 32. Rather, *Ishii* discloses a spiral high frequency antenna 24 acting as an induction member. See col. 6, lines 16-18 and Figures 1, 2, 4-10, 12, 24, and 28. *Ishii* also discloses a square single loop antenna in Figure 20 and a square spiral antenna in Figure 21.

However, *Ishii* fails to disclose or suggest a third serpentine coil, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion

of the third serpentine coil of claim 1; a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion as recited in claim 28; and a third coil having inner portions complementary to an outer surface of a second coil, outer portions complementary to an inner surface of a reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another as recited in claim 32.

The additional cited references do not cure the deficiencies of *Ishii*, therefore Applicants submit that for at least the reasons set forth above, claims 1, 28 and 32 is allowable. Claims 2, 3, 9-21, 25, and 27 depend from claim 1 and claims 29-31 depend from claim 28, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

c. *Nishikawa et al.*

Claims 1-3, 9-21, 25, and 27-32 over *Nishikawa et al.* (U.S. Patent No. 6,244,211, hereinafter referred to as "*Nishikawa*") in view of various other cited references. This rejection is respectfully traversed.

Similar to *Wang*, *Nishikawa* also fails to disclose or suggest the combination of features mentioned above from claims 1, 28 and 32. Rather, *Nishikawa* discloses, as illustrated in Figure 9, two looped antennas 71, 72 having different diameters. See col. 8, lines 46-50.

However, *Nishikawa* fails to disclose or suggest a third serpentine coil, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil

and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil of claim 1; a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion as recited in claim 28; and a third coil having inner portions complementary to an outer surface of a second coil, outer portions complementary to an inner surface of a reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another as recited in claim 32.

The additional cited references do not cure the deficiencies of *Nishikawa*, therefore Applicants submit that for at least the reasons set forth above, claims 1, 28 and 32 is allowable. Claims 2, 3, 9-21, 25, and 27 depend from claim 1 and claims 29-31 depend from claim 28, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

d. *Howald et al.*

Claims 1-3, 9-21, 25, and 27-32 over *Howald et al.* (U.S. Patent App. Pub. No. 2004/0124779, hereinafter referred to as "*Howald*") in view of various other cited references. This rejection is respectfully traversed.

Similar to *Wang*, *Howald* also fails to disclose or suggest the combination of features mentioned above from claims 1, 28 and 32. Rather, *Howald* discloses, as illustrated in Figure 1, concentric metal turns 162, 164 each of which has a square

cross-section and is shaped as a sector of a circle extending through an angle of approximately 340 degrees. See paragraph [0022]. *Howald* also discloses as illustrated in Figures 13-16, a loop 310, 316, or primary winding 1004 with secondary winding 1006, wherein the primary and secondary windings includes single planar, non-magnetic, metal substantially circular loops. See paragraph [0096].

However, *Howald* fails to disclose or suggest a third serpentine coil, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil of claim 1; a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion as recited in claim 28; and a third coil having inner portions complementary to an outer surface of a second coil, outer portions complementary to an inner surface of a reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another as recited in claim 32.

The additional cited references do not cure the deficiencies of *Howald*, therefore Applicants submit that for at least the reasons set forth above, claims 1, 28 and 32 is allowable. Claims 2, 3, 9-21, 25, and 27 depend from claim 1 and claims 29-31 depend from claim 28, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.



e. *Chen et al.*

Claims 1-3, 9-21, 25, and 27-32 over *Chen et al.* (U.S. Patent No. 6,164,241, hereinafter referred to as "*Chen*") in view of various other cited references. This rejection is respectfully traversed.

Similar to *Wang*, *Chen* also fails to disclose or suggest the combination of features mentioned above from claims 1, 28 and 32. Rather, *Chen* discloses, as illustrated in Figures 2A and 2B, two planar spiral coils 110a, 110b. See col. 1, lines 48-50. *Chen* also discloses as illustrated in Figure 3, single-turn coils coil 1, coil 2. See col. 3, lines 49-52. Additionally, *Chen* discloses, as illustrated in Figures 4-7, multiple turn coils including a toroidal coil in Figure 7.

However, *Chen's* toroidal coil is not serpentine in shape, and *Chen* fails to disclose or suggest a third serpentine coil, wherein the outer loop of the first serpentine coil and the outer loop of the third serpentine coil are approximately parallel, the inner loop of the first serpentine coil and the inner loop of the third serpentine coils are approximately parallel, the connecting portions of the first serpentine coil are approximately parallel to the connecting portions of the third serpentine coil and are longer than the connecting portions of the third serpentine coil, and the first serpentine coil does not overlap or cross the any portion of the third serpentine coil of claim 1; a serpentine continuous third portion surrounding, but not overlapping the serpentine continuous first portion as recited in claim 28; and a third coil having inner portions complementary to an outer surface of a second coil, outer portions complementary to an inner surface of a reaction chamber and connecting portions connecting the inner portions and the outer portions, and wherein the first, second and third coils do not overlap one another as recited in claim 32.

The additional cited references do not cure the deficiencies of *Chen*, therefore Applicants submit that for at least the reasons set forth above, claims 1, 28 and 32 is allowable. Claims 2, 3, 9-21, 25, and 27 depend from claim 1 and claims 29-31 depend from claim 28, and are allowable for at least the same reasons. Withdrawal of the rejection is respectfully requested.

**3. Conclusion**

Applicants invite the Examiner to contact Applicants' representative at the telephone number listed below if any issues remain in this matter, or if a discussion regarding any portion of the application is desired by the Examiner.

In the event that this paper is not timely filed within the currently set shortened statutory period, Applicants respectfully petition for an appropriate extension of time. The fees for such extension of time may be charged to our Deposit Account No. 02-4800.


In the event that any additional fees are due with this paper, please charge our Deposit Account No. 02-4800.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

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By:

  
Charles F. Wieland III  
Registration No. 33096

P.O. Box 1404  
Alexandria, VA 22313-1404  
703 836 6620